

## MYCOTAXON

<http://dx.doi.org/10.5248/123.213>

Volume 123, pp. 213–220

January–March 2013

**A new species of *Stropharia* from Western Ghats, India**GUNASEKARAN SENTHILARASU<sup>\*1</sup> & SANJAY K SINGH<sup>2</sup>

National Facility for Culture Collection of Fungi, MACS' Agharkar Research Institute,

G. G. Agarkar Road, Pune–411 004, India

CORRESPONDENCE TO \*: <sup>1</sup>[senthilarasu@rediffmail.com](mailto:senthilarasu@rediffmail.com) & <sup>2</sup>[singhsksingh@gmail.com](mailto:singhsksingh@gmail.com)

**ABSTRACT**—*Stropharia rubrobrunnea*, characterized by its caespitose habit, smooth grayish red or reddish to violet brown hygrophanous pileus, annular stipe, and dimorphic cheilocystidia, is described and illustrated as a new species. It is distinguished from *S. rugosoannulata* by its stipe color and basidiospore size.

**KEY WORDS**—*Agaricales*, *Basidiomycota*, dark-spored agarics, diversity, taxonomy

**Introduction**

The genus *Stropharia* (Fr.) Quél. (*Strophariaceae* Singer & A.H. Sm.) is poorly known from India, where only ten species have been recorded (Manjula 1983; Natarajan et al. 2005; Farook et al. 2013; Kumaresan & Senthilarasu, unpublished check list). Of these, *S. bicolor* Pegler, *S. rugosoannulata* Murrill (Manimohan et al. 2007), and *S. aurantiaca* (Cooke) M. Imai (Natarajan & Raman 1983) were recently recorded from southern India. Two excluded species are *S. pokhraensis* Dhanch. & Bakhukh. (Dhancholia & Bakhukhandi 1992), poorly known, and *S. semiglobata* (Batsch) Quél. (Natarajan & Raman 1983; Vrinda & Pradeep 2011; Mohanan 2011), which lacks true acanthocytes (Moncalvo et al. 2002) and has been transferred to *Protostropharia semiglobata* (Batsch) Redhead et al. The other poorly known species earlier recorded from India are *Stropharia aureofulva* (Berk.) Sacc. (as *Agaricus aureofulvus*), *S. gollanii* Henn., *S. mephistopheles* (Cooke) Sacc. (no material or illustration at Kew), *S. psathyroides* Henn., and *S. pygmaea* Henn. (Berkeley 1850, Hennings 1900). In the present paper, a new species collected from Western Ghats, *Stropharia rubrobrunnea*, is described, illustrated, and compared with closely related species.

**Materials & methods**

Thin handmade sections were made from dried specimens rehydrated with alcohol were mounted in 10% KOH and stained in 3% phloxine or cotton blue prior

to microscopical examination. Approximately 50 basidiospores were measured; the average spore range includes extreme values in parentheses. Colour terminologies follow Kornerup & Wanscher (1978). The type specimens are deposited at Ajrekar Mycological Herbarium (AMH), MACS' Agharkar Research Institute, Pune, India.

## Taxonomy

*Stropharia rubrobrunnea* Senthil. & S.K. Singh, sp. nov.

PLATE 1–3

MYCOBANK MB 564359

Differs from *S. rugosoannulata* by its white, smooth stipe and smaller basidiospores.

TYPE: India, Maharashtra state, Sinhgad, 18°21'56.39"N 73°45'18.97"E, 04.09.2011, coll.

G. Senthilarasu (holotype, AMH 9447).

ETYMOLOGY: '*rubrobrunnea*' refers to the colour of the pileus.

PILEUS 6–18 mm (closed pileus) to 30–100 mm (matured pileus), hemispheric to broadly parabolic, not umbonate, slightly areolate, exposing white background when young; becoming convex to plane, slightly depressed, finally uplifted, broadly umbonate in the shallow depression; surface grayish red (8C4–9C4), dull red (8D4), reddish brown (9E7), changing to violet brown (10E7–10E8) to grayish red (11D5) when young, strongly hygrophanous, pinkish white (7A2–11A2–11A3) on orange white (5A2) ground, becoming yellowish white (4A2), moist, smooth; margin incurved, becoming decurved to plane, finally uplifted, irregularly appendiculate, fugacious, not striate, entire, becoming eroded. LAMELLAE adnexed to adnate, ≤5 mm wide, grayish red (11D4) to violet brown (11F4–11F5), becoming blackish brown, crowded with numerous lamellulae, eroded. STIPE central, 30–120 × 2–13 mm, terete, equal, slightly tapering towards base; surface white, shiny, smooth, longitudinally striate, cartilaginous to fibrous, solid, arising from white to yellowish white (4A2) rhizomorphs. ANNULUS membranous, white, becoming vinaceous, rugulose, attached at the one third of the stipe. PILEUS CONTEXT white, ≤3 mm thick.

BASIDIOSPORES (7–)7.5–8.5(–10) × (4.5–)5–5.5(–6.5) µm, (8.01 ± 0.36 × 5.47 ± 0.28) µm, Q = 1.46, ellipsoid, slightly rhomboid in face-view, brown with thickened dark wall, apically truncated by a broad germ-pore, smooth. BASIDIA 17–21 × 7–8 µm, cylindric clavate, tetrasporic; sterigmata ≤4 × 1.5 µm. LAMELLA EDGE sterile with crowded dimorphic cheilocystidia: CHEILOCHRYSOCYSTIDIA 19–38 × 6.5–11 µm, sublageniform with a short mucronate apex, with subhyaline to yellowish contents, thin-walled. CHEILOLEPTOCYSTIDIA 20–52 × 6.5–10 µm, clavate to cylindric with mucronate to rostrate apex; rostrum ≤30 × 2.5 µm, sometimes sphaeropedunculate, branched, thin-walled. CHRYSOCYSTIDIA abundant on the sides of the gills, 20–51 × 7–14 µm, lageniform with short mucronate apex, containing subhyaline to yellowish contents, thick-walled. HYMENOPHORAL TRAMA regular, with thin-walled, hyaline hyphae, 3–20 µm diam. SUBHYMENIUM well developed, ≤20 µm wide, pseudoparenchymatous.



PLATE 1. *Stropharia rubrobrunnea* basidiomata under natural conditions: a. Young basidiomata. b. Mature basidiome showing rugulose annulus. c. Gill view of mature basidiome. (Photo Senthilarasu.)

**PILEAL SURFACE** a regular cutis of radially repent hyphae, 2–30  $\mu\text{m}$  diam.  
**PILEAL CONTEXT** with hyaline hyphae 3–23  $\mu\text{m}$  diam., thin-walled with clamp connections. **STIPITIPELLIS** with hyaline hyphae 2–17  $\mu\text{m}$  diam., thin-walled, clamped. **RHIZOMORPH** with sphaerocytes and hyaline hyphae,  $\leq 7$   $\mu\text{m}$  diam, clamped; sphaerocytes  $\leq 96 \times 82$   $\mu\text{m}$ , globose to subglobose or ovate, hyaline, thin-walled; acanthocytes with several outgrowths,  $\leq 83 \times 3.7$   $\mu\text{m}$ , thick-walled,  $\leq 1.7$   $\mu\text{m}$  thick, arising from a solid base, hyaline.

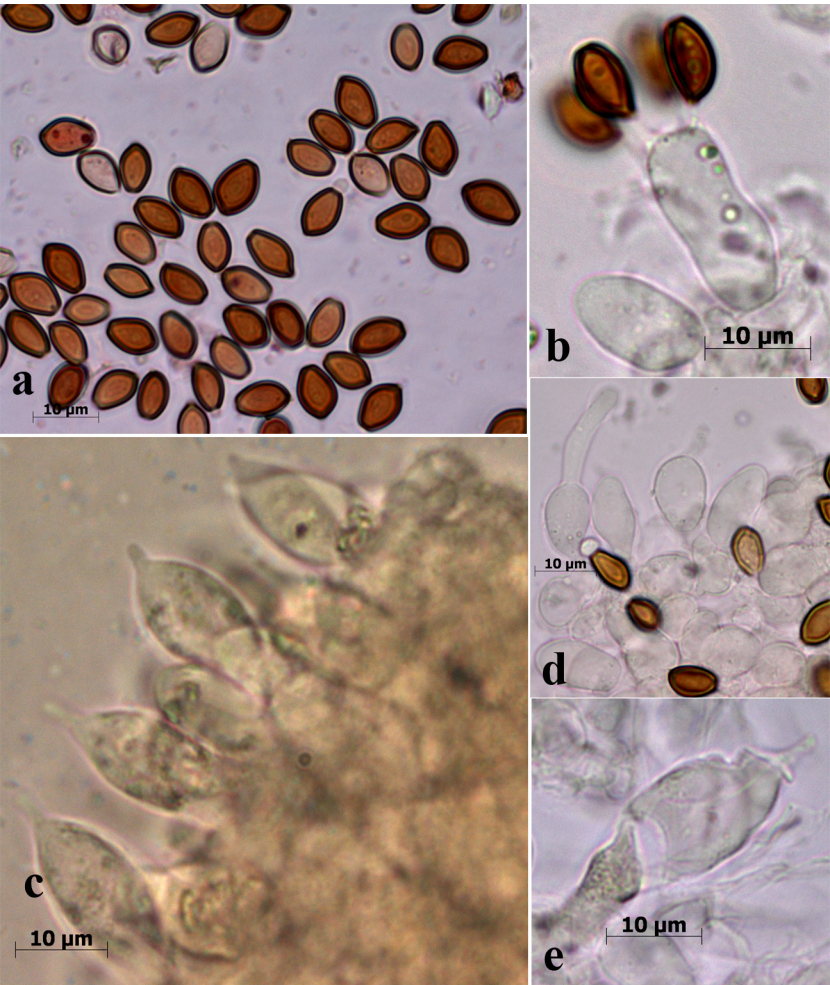


PLATE 2. *Stropharia rubrobrunnea*: a. Basidiospores. b. Basidia. c. Cheilochrysocystidia. d. Cheileleptocystidia. e. Pleurochrysocystidia.

ECOLOGY & DISTRIBUTION: Solitary to caespitose to connate, on decayed gunny bag, in mixed forest vegetation. Known only from type locality.

The diagnostic features of *Stropharia rubrobrunnea* are the grayish red, reddish brown to violet brown pileus, white stipe with a membranous grooved annulus, and spores  $\leq 10\ \mu\text{m}$  long.

Recently, several *Stropharia* species have been described from the neotropical region (Cortez & Coelho 2004, 2008, Bandala et al. 2005, Silva et

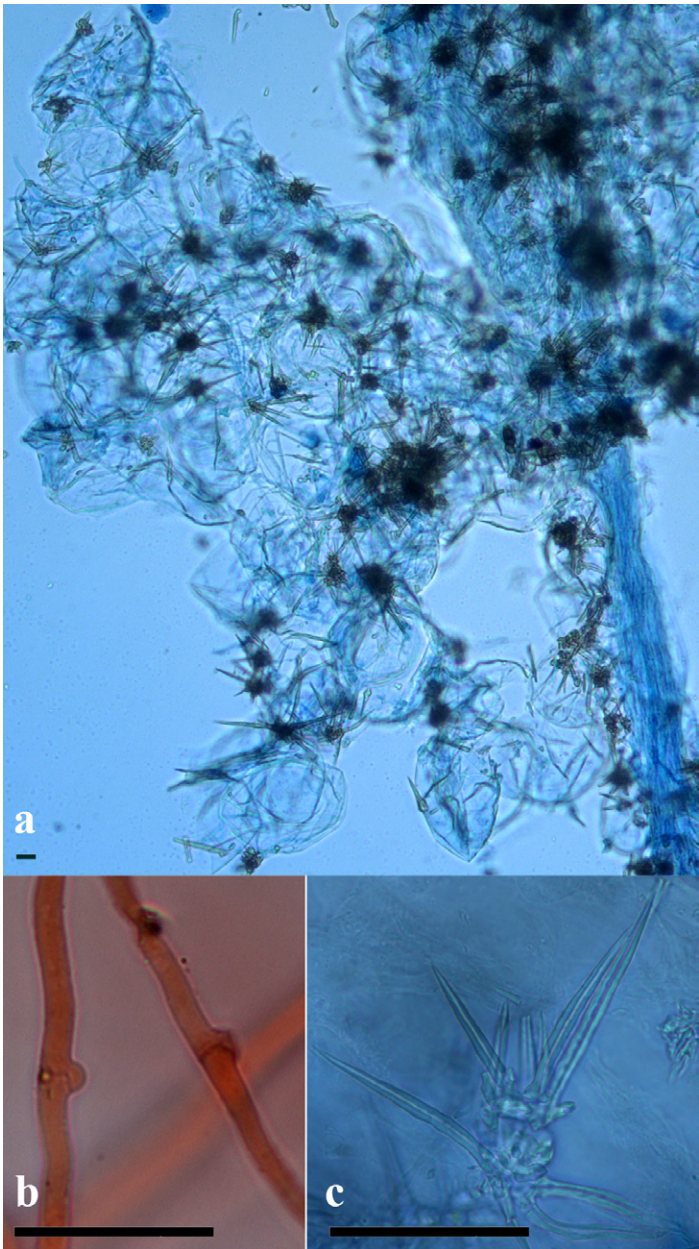


PLATE 3. *Stropharia rubrobrunnea* rhizomorph: a. Sphaerocytes along with acanthocytes. b. Hyphae with clamp connections. c. Acanthocyte.

al. 2006, 2009, Cortez & Silveira 2007, 2008, Cortez 2008a,b) and China (Bau & Meng 2008). *Stropharia rubrobrunnea* resembles the most common species *S. rugosoannulata* (Cortez & Silveira 2008) in similar sized basidiomes. Although the pileus colour in *S. rugosoannulata* is highly variable, it has a yellowish brown stipe covered with brownish fibrils and larger basidiospores ( $9.5\text{--}14.5 \times 6.5\text{--}8 \mu\text{m}$ ) and basidia ( $21\text{--}38 \times 8\text{--}12 \mu\text{m}$ ).

*Stropharia coronilla* (DC.) Quél. and *S. araucariae* Cortez & R.M. Silveira (Cortez & Silveira 2008) also have a fleshy grooved annulus. Although *S. araucariae* also has leptocystidia and chrysocystidia at the gill edge, it differs from *S. rubrobrunnea* in its umbonate dark grayish brown pileus and larger basidiospores ( $10.5\text{--}13 \mu\text{m}$  long). The basidiospore size ( $6.5\text{--}10.5 \times 4.5\text{--}6.5 \mu\text{m}$ ) in *S. coronilla* is similar to that in *S. rubrobrunnea*, but it is a grassland inhabiting mushroom and differs morphologically in smaller basidiome size (pileus =  $16\text{--}55 \text{ mm}$  diam.; stipe =  $18\text{--}51 \text{ mm}$  long), yellowish colored pileus, and absence of cheilochrysocystidia.

The neotropical species *S. venusta* P.S. Silva et al., known only from *Araucaria angustifolia* forests of southern Brazil (Silva et al. 2009), also somewhat resembles *S. rubrobrunnea* in the larger basidiome size, grayish red to reddish brown pileus, and rugulose annulus. However, *S. venusta* clearly differs in its greenish grey colored stipe covered with scattered white squamules, larger basidiospores ( $11\text{--}15 \times 6\text{--}10 \mu\text{m}$ ) and chrysocystidia ( $35\text{--}70 \times 7\text{--}16 \mu\text{m}$ ), and absence of cheilochrysocystidia.

*Stropharia variicolor* Desjardin & Hemmes (Desjardin & Hemmes 2001) and *S. cifuentesii* Bandala et al. (Bandala et al. 2005) with their reddish to reddish brown colored pilei somewhat superficially resemble *S. rubrobrunnea*. *Stropharia variicolor* also has similar sized basidiospores ( $6.5\text{--}9 \times 4.5\text{--}5.7 \mu\text{m}$ ) but differs in smooth annulus, smaller cheileptocystidia ( $17.5\text{--}26 \mu\text{m}$ ) that lack a rostrum, and an absence of cheilochrysocystidia. *Stropharia cifuentesii* clearly differs in its smaller basidiome size (pileus =  $8\text{--}30 \text{ mm}$  diam.; stipe =  $9\text{--}37 \text{ mm}$  long), fibrillose to squamulose pileus, whitish to yellowish brown lamellae, more slender stipe, absence of a fleshy annulus, smaller spores ( $5.5\text{--}7 \mu\text{m}$ ), and absence of cheilocystidia.

### Acknowledgments

We thank Prof. Vagner G. Cortez and Dr. Gastón Guzmán for critically reviewing the manuscript. GS personally thanks Prof. V. Cortez, Dr. V. Kumaresan and Dr. CK Pradeep for providing literature on *Stropharia*. We greatly acknowledge Dr. Shaun Pennycook and Dr. Lorelei Norvell for presubmission reviews. Sincere thanks to the Director, Agharkar Research Institute, for providing all laboratory facilities. We thank the Department of Science and Technology (DST), Government of India, New Delhi, for providing financial support for the project National Facility for Culture Collection of Fungi, Agharkar Research Institute, Pune, India.

## Literature cited

- Bandala VM, Montoya L, Jarvio D. 2005. Agarics from coffee plantations in Eastern Mexico: two new records. *Fungal Diversity* 20: 17–29.
- Bau T, Meng TX. 2008. *Strophariaceae* of China (II) *Stropharia*. *Journal of Fungal Research* 6(1): 7–34.
- Berkeley MJ. 1850. Decades of fungi. Decades XXV to XXX. Sikkim Himalayan fungi, collected by Dr. J.D. Hooker. *Hooker's Journal of Botany and Kew Gardens Miscellany* 2: 42–51, 76–88, 106–112.
- Cortez VG. 2008a. Type studies on South American *Strophariaceae*: 1. *Pholiota varzeae* from the Brazilian Amazon. *Mycotaxon* 103: 137–140.
- Cortez VG. 2008b. Type studies on South American *Strophariaceae*: 2. *Pholiota trinitensis* is transferred to *Stropharia*. *Mycotaxon* 105: 7–10.
- Cortez VG, Coelho G. 2004. The *Stropharioideae* (*Strophariaceae*, *Agaricales*) from Santa Maria, Rio Grande do Sul, Brazil. *Mycotaxon* 89(2): 355–378.
- Cortez VG, Coelho G. 2008. Occurrence of the rare agaric *Stropharia melanosperma* (*Strophariaceae*) in Brazil. *Bol. Soc. Micol. Madrid* 32: 49–55.
- Cortez VG, Silveira RMB. 2007. A new species of *Stropharia* with hymenial acanthocytes. *Mycologia* 99(1): 135–138. <http://dx.doi.org/10.3852/mycologia.99.1.135>
- Cortez VG, Silveira RMB. 2008. The agaric genus *Stropharia* (*Strophariaceae*, *Agaricales*) in Rio Grande do Sul State, Brazil. *Fungal Diversity* 32: 31–57.
- Dhancholia S, Bakhukhandi D. 1992 [“1991”]. New records of agarics from India. *Indian Journal of Mycology and Plant Pathology* 21(3): 248–250.
- Desjardin DE, Hemmes DE. 2001. *Agaricales* of the Hawaiian Islands–7. Notes on *Volvariella*, *Mycena* sect. *Radiatae*, *Physalacria*, *Porpoloma* and *Stropharia*. *Harvard Papers in Botany* 6(1): 85–103.
- Farook AV, Khan SS, Manimohan P. 2013. A checklist of agarics (gilled mushrooms) of Kerala State, India. *Mycosphere* 4(1): 97 – 131. <http://dx.doi.org/10.5943/mycosphere/4/1/6>
- Hennings P. 1900. *Fungi Indiae Orientalis*. *Hedwigia Beiblätter* 39: 150–153.
- Kornerup A, Wanscher JH. 1978. *Methuen handbook of colour*. 3<sup>rd</sup> ed. Eyre Methuen, London 243 p.
- Manjula B. 1983. A revised list of the agaricoid and boletoid basidiomycetes from India and Nepal. *Proc. Indian Academy of Sci. (Pl. Sci.)* 92: 81–213.
- Manimohan P, Thomas AK, Nisha VS. 2007. Agarics on elephant dung in Kerala. *Mycotaxon* 99: 147–157.
- Mohan C. 2011. *Macrofungi of Kerala*. KFRI Handbook No. 27, Kerala Forest Research Institute, Peechi, Kerala, India 597p.
- Moncalvo JM, Vilgalys R, Redhead SA, Johnson JE, James TY, Aime MC, Hofstetter V, Verduin SJW, Larsson E, Baroni TJ, Thorn RG, Jacobsson S, Clémence H, Miller Jr. OK. 2002. One hundred seventeen clades of euagarics. *Molecular Phylogenetics and Evolution* 23: 357–400. [http://dx.doi.org/10.1016/S1055-7903\(02\)00027-1](http://dx.doi.org/10.1016/S1055-7903(02)00027-1)
- Natarajan K, Kumaresan V, Narayanan K. 2005. A checklist of Indian agarics and boletes (1984–2002). *Kavaka* 33: 61–128.
- Natarajan K, Raman N. 1983. South Indian *Agaricales*. A preliminary study on some dark spored species. *Bibliotheca Mycologica* 89: 1–203.
- Silva PS, Cortez VG, Silveira RMB. 2006. The mycobiota of Itapuã Park, Rio Grande do Sul, Brazil. I. Species of *Strophariaceae* (*Agaricales*). *Mycotaxon* 97: 219–229.

- Silva PS, Cortez VG, Silveira RMB. 2009. New species of *Stropharia* from *Araucaria angustifolia* forests of southern Brazil. *Mycologia* 101(4): 539–544. <http://dx.doi.org/10.3852/08-097>
- Vrinda KB, Pradeep CK. 2011. Toxic and hallucinogenic mushrooms of Kerala. *Journal of Mycopathological Research* 49(2): 231–246.